Statement of Work for NASA Manufacturing Technology Transfer Center
Attachment A
Dated 11/3/2011

1.0 Introduction

In order to meet its mission, GSFC has the need for NASA and GFSC training courses which are delivered by NASA Level A certified instructors and Certified IPC Trainers (CIT) in a manner which is compliant with NASA's internal policies for operating NASA Workmanship Training Centers. The curriculum for the courses, including the definition of all class materials, is predefined and pre-existing. These courses are a mixture of classroom instruction and hands-on practicum which requires specialized facilities which both enable the practicum portion and ensure student safety and the safety of government furnished equipment and which are located within 30 miles of Greenbelt, MD. Course availability across the curriculum as well as by student volume is a critical component of this procurement. Courses will be procured for a student body that consists of GSFC, civil servant personnel and personnel associated with the Canadian Ministry of Defense. The majority of the Workmanship courses are those which are prerequisites for operator, inspector, and instructor certification to the NASA-STD-8739 Workmanship requirements document series the J-STD-001ES Soldering Standard, the IPC/WHMA-A-620AS Cable and Wire Harness Standard, and the GSFC-WM-001Belectrostatic discharge (ESD) control plan. NASA's workmanship training standards are located at: http://www.hq.nasa.gov/office/codeq/doctree/qa.htm# , the IPC standards are available at www.ipc.org, and the GSFC ESD manual is Attachment 3 herein. Student records management and delivery is required. Records related to GSFC government furnished equipment (GFE) are required.

2.0 Background

The Eastern NASA Manufacturing Technology Transfer Center (E-NMTTC) has been providing specialized training on Workmanship topics since 1998, though the concept of Workmanship Standards training dates to the 1980's. The requirement that all operators performing soldering, conformal coating application, staking, bonding, cable harness assembly, and handling of Electrostatic Discharge (ESD) sensitive items in mission hardware, be trained and certified, dates to 2005. The training requirements are imposed by reference by the NASA policy directive NPD 8730.5, NASA Quality Assurance Program Policy, and are detailed in each of the documents shown Table 2-1. Training is also required by these documents for quality inspectors and instructors. GSFC-WM-001B is a GFSC-specific standard which requires operators, instructors, and Program Monitors to be trained. Attachment 1 herein is training and training center policy that supersedes the training requirements in the individual NASA-STD-8739 Workmanship Standards. Training in all of these cases is a prerequisite for personnel certification.

The courses taught at the E-NMTTC serve NASA GSFC, other NASA field Centers, industry, other US Government Agencies including the Department of Defense (DoD), academia, and non-US entities such as the Canadian Space Agency. Though this procurement is only for courses to be taken by GSFC civil servants, the course load provided to non-GSFC civil servants has been instrumental to maintaining the volume and variety of course availability needed by GSFC. The curriculum offered to GSFC includes

courses which are required for personnel technical certifications (e.g. soldering, cable harness assembly, operations in ESD controlled areas) and courses which enhance technical or vocational technical knowledge (e.g. repair/rework, Introduction to Workmanship Standards). Table 2-2a and 2-2b show the courses and student volume for fiscal year 2010 and fiscal year 2011. Attachment 2 contains course descriptions for each of the courses shown in Tables 2-2a and 2-2b. Though the historical record shows low or no attendance by civil servants for several of the classes, those courses must be made available to GSFC civil servants in the future.

NASA Headquarters' Office of Safety and Mission Assurance has an agreement with the Canadian Ministry of Defense (CMD) which enables GSFC to cover the cost of tuitions of CMD employees who take Workmanship Standards training at E-NMTTC. Approximately twenty (20) CMD students participate in this arrangement. Note: The attendance volume by class type for CMD students is rolled into the data for all GSFC civil servants shown in Tables 2-2a and 2-2b.

Course content follows the applicable standard such that students are taught all of the requirements in that standard. Courses are updated to reflect the current published revision though non-NASA students may request courses by prior revision to satisfy contractual requirements. Quizzes and tests are used to evaluate students' successful completion of the course (see Attachment 1 for pass/fail criteria). Workbooks are used and copies of the standard are supplied to each student. Electronic versions of all course materials are available from GSFC.

The courses offered by the E-NMTTC are between a half-day in duration to seven days in duration. Most of the courses contain a practicum element. Practicum include hand-soldering and machine-soldering printed wiring assemblies, construction of cable harnesses, terminating optical fibers, applying polymeric materials to printed wiring assemblies (e.g. staking, bonding), inspecting finished articles for defects, and performing resistance measurements on ESD-control workstations. The course materials provided contain descriptions of the practical exercises that are to be performed.

Some government furnished equipment (GFE) is available that can be used to deliver the required courses though this GFE is not the full suite required for adequate delivery of the required courses. GFE items are not replaced after they become unusable due to obsolescence, damage, or wear out. A list of the GFE available to the E-NMTTC is in Table 5-1.

Courses taken for technical certification are required to be repeated biennially. For these courses which are for personnel certification, registration is managed to separate students eligible for shortened retraining classes from those who must take the longer "Initial" version. Training records are managed to enable traceability of personnel certifications to the training they took and the instructor who delivered the course. The E-NMTTC shall be able to confirm the training credentials of the students that have successfully completed courses taught there.

Instructors in the E-NMTTC are considered Level A instructors and are certified by the NASA Workmanship Standards Program Manager based on experience as a Workmanship instructor (NASA, IPC, or equivalent), and compliance with the applicable requirements in Attachment 1 (vision, regular

activity, competency, participation in standards reviews). NASA Level A instructors are certified biennially. Instructors who teach IPC J-STD-001xS courses must be certified IPC CIT's or MIT's (CIT = certified IPC trainer, MIT = master IPC trainer).

Attachment 1 details applicable policy for Workmanship Standards training and operation of the E-MTTC.

Table 2-1 Standards Applicable to Certification Training Courses

Title	Number
Workmanship Standard for Polymeric Application on Electronic Assemblies	NASA-STD 8739.1
Workmanship Standard for Surface Mount Technology	NASA-STD 8739.2
Workmanship Standard for Soldered Electrical Connections	NASA-STD 8739.3
Workmanship Standard for Crimping, Interconnecting Cables, Harnesses, and Wiring	NASA-STD 8739.4
Workmanship Standard for Fiber Optic Terminations, Cable Assemblies, and Installation	NASA-STD 8739.5
Workmanship Manual for Electrostatic Discharge Control (Excluding Electrically Initiated Devices)	GSFC-WM-001
Space Applications Electronic Hardware Addendum to J-STD-001E Requirements for Soldered Electrical and Electronic Assemblies	IPC J-STD-001ES

Note: These NASA standards are located at: http://www.hq.nasa.gov/office/codeq/doctree/qa.htm#. The IPC standard is located at www.ipc.org.

3.0 Scope

The Contractor shall provide a NASA Level A workmanship standards training program as the E-NMTTC. The E-NMTTC is to be capable of furnishing workmanship training to GSFC civil servants, support contractors, and external NASA and non-NASA personnel for the variety of courses and the volume of students shown in Tables 2-1a and 2-1b. This capability will be employed to train GSFC civil servants and employees of the Canadian Ministry of Defense across the full course catalog on a schedule like that shown in Tables 2-1a and 2-1b. The E-NMTTC shall be compliant with applicable training and training center policy found in Attachment 1. The services and operations sought include providing all qualified personnel, facilities, and equipment; delivery of training courses to GSFC civil servants and employees of the Canadian Ministry of Defense; management of student registrations and training records; maintenance of course content to track with currently published versions of workmanship standards invoked by NPD 8730.5; and use and return of applicable GFE.

Table 2-2a Training Courses Required and Student Load
(Number of GSFC Civil Servant Students/Number all Students Attending)

	8739.1 Operator Initial	8739.1 Level B Instructor Initial	8739.1 Operator Re-training	8739.1 Level B Instructor Re-training	8739.1 Inspector Initial/Re-training	8739.2 Operator/Inspector Initial	8739.2 Level B Instructor Initial	8739.2 Operator/Inspector Re-training	8739.2 Level B Instructor Re-training	8739.3 Operator/Inspector Initial	8739.3 Level B Instructor Initial	8739.3 Operator/Inspector Re-training	8793.3 Level B Instructor Re-training	8739.4 Operator/Inspector Initial	8739.4 Level B Instructor Initial	8739.4 Operator/Inspector Re-training	8739.4 Level B Instructor Re-training
October-09	0/0	0/0	0/0	0/0	2/6	0/0	0/0	0/2	0/0	0/6	0/2	0/5	0/1	0/13	0/1	0/0	0/0
November-09	1/3	0/1	0/1	0/3	2/12	3/10	0/4	0/2	0/4	1/6	0/1	0/2	0/11	0/0	0/0	0/6	0/9
December-09	0/3	0/1	0/0	0/0	0/0	0/2	0/3	0/0	0/0	4/5	0/1	1/7	0/1	3/12	0/0	1/4	0/1
January-10	0/0	0/0	0/0	0/0	1/7	0/1	0/2	0/9	0/0	0/5	0/1	0/4	0/2	0/0	0/0	0/7	0/1
February-10	0/1	0/3	0/0	0/0	0/0	0/0	0/0	0/5	0/1	0/5	0/3	0/4	0/4	0/0	0/0	0/0	0/0
March-10	0/3	0/1	1/1	0/3	1/8	0/3	0/1	0/3	0/4	1/6	0/1	0/7	0/2	0/10	0/4	0/3	0/5
April-10	0/1	0/1	0/2	0/1	0/2	0/5	0/2	0/0	0/0	0/4	0/4	0/5	0/2	1/14	0/1	0/7	0/4
May-10	0/0	0/0	0/3	0/2	0/3	1/7	0/1	2/8	0/0	0/10	0/1	1/4	0/5	1/6	0/2	0/6	0/2
June-10	0/3	0/1	0/0	0/0	1/7	0/0	0/0	0/4	0/0	0/4	0/4	1/8	0/3	0/0	0/0	2/16	0/3
July-10	0/3	0/1	1/2	0/2	0/16	1/3	0/1	0/2	0/2	1/5	0/3	0/3	0/1	0/5	0/1	0/6	0/1
August-10	0/0	0/0	0/2	0/1	0/4	0/0	0/0	0/5	0/0	1/7	0/1	0/10	0/2	1/13	0/2	0/7	0/0
September-10	0/2	0/2	0/3	0/1	0/0	0/5	0/0	0/5	0/0	1/13	0/0	0/6	0/2	0/0	0/0	0/3	0/1
Total 2010	1/19	0/11	2/14	0/13	7/65	5/36	0/14	2/45	0/11	9/76	0/22	3/65	0/36	6/73	0/11	3/65	0/27
October-10	0/3	0/1	0/0	0/0	0/11	0/4	0/1	0/7	0/2	0/0	0/0	0/4	0/4	0/5	0/0	0/8	0/7
November-10	1/5	0/0	0/2	0/3	0/6	0/3	0/3	0/0	0/0	0/13	0/2	0/5	0/2	0/2	0/4	0/0	0/0
December-10	0/0	0/0	0/0	0/0	0/0	0/0	0/0	1/6	0/1	0/0	0/0	0/1	0/6	0/0	0/0	0/6	0/1
January-11	0/4	0/0	0/0	0/0	0/6	0/1	0/1	1/6	0/2	0/6	0/1	0/16	0/1	0/0	0/0	9/12	0/2
February-11	2/3	0/1	0/1	0/1	0/7	0/2	0/0	0/2	0/1	0/6	0/2	1/6	0/1	0/5	0/2	0/7	0/1
March-11	0/2	0/0	0/1	0/2	0/3	0/0	0/0	1/5	0/0	0/4	0/2	0/10	0/5	0/6	0/0	0/3	0/1
April-11	0/3	0/0	1/1	0/3	1/6	0/0	0/2	0/3	0/1	1/6	0/2	1/4	0/4	0/3	0/1	0/10	0/1
May-11	0/0	0/1	0/1	0/2	0/4	0/3	0/0	0/7	0/1	0/4	0/2	0/5	0/3	1/6	0/2	1/13	0/2
June-11	0/0	0/0	0/0	0/0	0/0	1/5	0/0	0/0	0/0	1/4	0/0	1/8	0/0	0/0	0/0	1/7	0/0
July-11	1/0	0/3	0/0	0/1	0/3	0/5	0/1	3/5	0/4	0/6	0/1	1/5	0/4	0/3	0/3	0/5	0/2
August-11	0/0	0/0	1/1	0/7	1/4	0/0	0/0	1/3	0/4	0/4	0/5	2/8	0/0	1/2	0/0	0/4	0/2
September-11	0/2	0/1	0/0	0/0	2/2	1/1	0/4	0/0	0/0	0/5	0/2	0/3	0/3	0/0	0/0	1/3	0/2
Total 2011	4/22	0/7	2/7	0/19	4/52	2/24	0/12	7/44	0/16	2/58	0/19	6/75	0/33	2/32	0/12	12/78	0/21

Table 2-2b Training Courses Required and Student Load
(Number of GSFC Civil Servant Students/Number all Students Attending)

	8739.5 Operator/Inspector Initial	8739.5 Level B Instructor Initial	8739.5 Operator/Inspector Re-training	8739.5 Level B Instructor Re-training	GSFC-WM-001BOperator	GSFC-WM-001BLevel B Instructor / Program Monitor	J-STD-001xS CIS or CIT	Workmanship Overview	Connector Mate/Demate	Rework Repair
October-09	0/4	0/0	0/0	0/0	11/16	0/0	0/0	0/0	0/0	0/0
November-09	0/4	0/1	0/1	0/0	11/14	0/0	0/0	0/0	0/0	0/0
December-09	0/0	0/0	0/0	0/0	8/15	2/7	0/0	0/0	0/0	0/0
January-10	0/0	0/0	0/0	0/0	11/17	0/2	0/0	0/0	0/0	1/2
February-10	0/4	0/0	0/0	0/0	7/16	0/0	0/0	0/0	0/0	0/0
March-10	0/0	0/0	0/1	0/1	9/17	0/2	0/0	0/0	0/0	0/0
April-10	0/0	0/0	0/0	0/0	8/14	0/2	0/0	0/0	0/0	0/0
May-10	0/1	0/0	0/0	0/0	6/11	0/0	0/0	0/0	0/0	0/0
June-10	0/0	0/0	0/2	0/0	22/45	0/2	0/0	0/0	9/14	0/0
July-10	0/0	0/0	0/0	0/0	23/31	0/2	0/1	0/0	0/0	0/0
August-10	0/0	0/0	0/0	0/0	0/14	0/0	0/3	0/0	0/0	0/1
September-10	0/0	0/0	0/0	0/0	10/33	0/4	0/0	0/0	3/7	0/0
Total 2010	0/13	0/1	0/4	0/1	126/243	2/21	0/4	0/0	12/21	1/3
October-10	0/0	0/0	0/1	0/1	33/53	0/0	0/0	0/0	0/0	0/0
November-10	0/0	0/0	0/0	0/0	35/60	0/0	0/0	0/0	8/27	0/0
December-10	0/4	0/2	0/0	0/0	12/16	0/6	0/2	0/0	0/0	0/0
January-11	0/0	0/0	0/0	0/0	16/22	0/0	0/0	0/0	0/0	0/0
February-11	0/0	0/1	0/0	0/0	28/38	4/12	0/2	0/1	0/0	0/0
March-11	0/5	0/0	0/0	0/0	12/28	0/2	0/0	0/3	0/0	0/0
April-11	0/0	0/0	0/2	0/0	39/51	1/11	0/0	0/0	11/12	0/0
May-11	0/0	0/0	0/0	0/0	31/45	0/0	0/0	0/0	0/0	0/0
June-11	0/0	0/0	0/0	0/0	26/31	2/5	0/0	0/0	10/14	0/0
July-11	0/0	0/0	0/4	0/0	12/20	1/6	0/2	0/0	0/0	0/0
August-11	0/2	0/1	0/0	0/0	24/7	3/2	0/0	0/0	5/4	0/0
September-11	0/0	0/0	0/2	0/1	17/18	2/7	0/0	0/0	5/4	0/0
Total 2011	0/11	0/4	0/7	0/2	285/389	12/51	0/6	0/4	39/61	0/0

Total Number of All Students in FY10:	914
Total Number of GSFC Students in FY10:	179
Total Number of All Students in FY11:	1443
Total Number of GSFC Students in FY11:	377

4.0 Applicable Documents

NASA-STD-8739.1	Workmanship Standard for Polymeric Application on Electronic Assemblies
NASA-STD-8739.2	Workmanship Standard for Surface Mount Technology
NASA-STD-8739.3	Workmanship Standard for Soldered Electrical Connections
NASA-STD-8739.4	Workmanship Standard for Crimping, Interconnecting Cables, Harnesses, and Wiring
NASA-STD-8739.5	Workmanship Standard for Fiber Optic Terminations, Cable Assemblies, and Installation
NASA-STD-8739.6	Implementation Requirements for NASA Workmanship Standards
ANSI/ESD S20.20	Standard for the Development of an ESD Control Program for the Protection of Electrical and Electronic Parts, Assemblies, and Equipment (Excluding Electrically Initiated Explosive Devices)
GSFC-WM-001	Workmanship Manual for Electrostatic Discharge Control (Excluding Electrically Initiated Devices)
IPC J-STD-001ES	Space Applications Electronic Hardware Addendum to J-STD-001E Requirements for Soldered Electrical and Electronic Assemblies
IPC/WHMA-A-620AS	Space Applications Electronic Hardware Addendum to IPC/WHMA-A-620A (wire harness standard)

5.0 Technical Requirements

5.1 Training Course Content. The course content shall teach the requirements included in the current revision of the standards listed in Table 2-1. The course content shall include student practical exercises which demonstrate their grasp of the material and capability to manufacture and/or inspect compliant product as an operator, inspector, or instructor. Level B Instructor courses shall contain content relevant to effective teaching methods.

Courses for NASA-adopted industry Workmanship Standards shall be provided. This requirement applies to IPC J-STD-001ES. This requirement does not apply to ANSI/ESD S20.20 because ESD training is done in accordance with the organization's local plan; GSFC-WM-001Bin GSFC's case. IPC/WHMA-A-620AS is expected to become a NASA-adopted Standard within this contract's period of performance.

Prior versions of NASA Workmanship Standards training shall be provided as needed to serve students working to legacy mission assurance requirements baselines.

Quizzes shall be used for interim review of content. A final exam and graded practical exercise shall be used to evaluate students' successful completion of the course. All quizzes and exams shall be proctured by a certified instructor. Attachment 1describes the rules to be used for determining passing grades for the NASA-STD-8739 courses. IPC policy shall apply for delivery of IPC courses. GSFC-WM-001Bdescribes the rules to be used for passing grades for ESD training.

Both an "Initial" version and a "Retraining" version of each course used for personnel certification shall be offered. The "Initial" version shall cover all requirements in the applicable standard. "Retraining" courses shall be focused on overview of the requirements, awareness of lessons learned, and awareness of new content or policy. Existing course materials used by the E-NMTTC for NASA-STD-8739 Workmanship Standards training will be provided to the awardee including slide presentations, bills of materials for practical exercises, quizzes, and exams. Course materials shall be improved and updated as needed to adequately represent content of the applicable standard. IPC course materials are available from the IPC to certified IPC instructors.

Courses shown in Tables 2-2a and 2-2b which are not associated with the standards in Table 2-1 shall be overview courses and are not required to meet a predefined policy on content, testing, or prerequisites.

5.2 Instructors. Instructors for all NASA-STD-8739 courses and the GSFC-WM-001Bcourses shall be certified by the NASA Workmanship Standards Program Manager based on prior Workmanship experience, instructor experience, continued competency, the applicable requirements in Attachment 1. IPC courses shall be taught by IPC certified instructors. Workmanship instructors shall have expert knowledge of typical manufacturing processes for the assembly of electronic systems for use in space flight hardware including but not limited to: soldering, crimping, cable and harness assembly, application of polymeric materials (e.g. coatings, staking, encapsulation), electrostatic discharge (ESD) control, and photonics assembly (fiber optics).

5.3 Course Availability. The NASA-STD-8739 and GSFC-WM-001Bcourses are prerequisites for vocational technical certifications and shall be available to GSFC civil servants and employees of the Canadian Ministry of Defense (CMD). Except for emergency/unscheduled training, the course schedule shall be provided to the GSFC training office (Code 114) a minimum of 6 months in advance. The course schedule information shall include course name, instructor, course dates, minimum number of students, maximum number of students, course prerequisites, cost, location, the last day to register, and the date the course will be cancelled due to insufficient class size. The same course information shall be provided to the GSFC training office as soon as it is available for emergency/unscheduled training.

The Contractor shall give first priority to the training of GSFC Government employees; second priority to other NASA employees, third priority to all other Government employees and GSFC contractor personnel; and lowest priority to all others. The contractor shall comply with Attachment 1 when training non-NASA personnel and foreign nationals.

The Government may require the contractor to conduct emergency/unscheduled training for GSFC project personnel (civil servant and contractor). The contractor shall be capable of adjusting course schedules to react to GSFC short-notice needs including offering one-on-one instruction and off-facility instruction. Off-facility instruction where adequate facilities are not available will be limited to ESD training. Off-facility instruction will normally be within the continental United States and may require the shipment of training materials, equipment, and documentation. Pricing adjustment will be allowed to cover the additional costs associated with off-facility training.

5.4 Registrar Services. The offerer shall provide registrar services including web-based posting of the courses offered, the fee schedule and fee policies, course prerequisites, and the current course schedule. Registration shall be accommodated by hard copy (US mail), fax, phone, or attachment to email. A

web-based registration option is desired but not required. Registrar services will include processing and managing student registrations which comply with the applicable requirements in Attachment 1. There are no NASA-imposed limitations on students who seek to register for IPC courses. The contractor shall bill GSFC for the tuition associated with the courses completed by GSFC and CMD students only.

For all students who pass the course, a training card shall be provided to the student with the following minimum information:

a. Student's name
b. Course taken
c. Date course successfully completed
d. Signature of Instructor (indicating successful completion of the course)
e. Company name
f. Blank line for the student's supervisor to sign (indicating certification status)
g. Date of supervisor's signature

Both sides of the training card may be used. The training card shall be provided within a week of successful completion of the course.

A point of contact shall be made available to past, current and prospective students who can provide answers to questions about registration, student records, student policies, fee policies, and training center logistics in a timely manner.

5.5 Student Records. The offerer shall create and retain student records which indicate the courses successfully passed, the dates the courses were taken, and the instructors who taught the courses. These records are used for assuring compliance with the requirements in Attachment 1 regarding course registration. These records shall be provided to the GSFC training office (Code 114) within thirty days of course completion, and shall be made suitable for transfer to NASA's other Workmanship Standards Training Centers and NASA Projects for verifying personnel training status. These training records shall be retained for a minimum of three years.

5.6 Facilities, Equipment, and Materials. The contractor shall provide a classroom facility that accommodates both lecture and practical instruction that is comfortable, functional, and safe for the students. A minimum of twelve students shall be accommodated per class. Adequate ventilation is required when soldering is being performed. Control of optical fiber scrap must be provided to prevent injury. **The facility shall be within a 30-mile radius of NASA GSFC's Greenbelt, MD campus**.

The facility is required to meet National Environmental Policy Act (NEPA), mini-NEPA (regarding local environmental laws), and Occupational Safety and Health Administration (OSHA) requirements. The operation and management of the facility shall protect the physical assets therein, the employees and students therein, the electronic and hard-copy records, and any sensitive data that is subject to US international trade and arms (ITAR) regulations.

Course materials and training aids must be 508 complaint, course materials must be sent in an electronic format 14 business days prior to the course. This does not apply to Workmanship courses (operator,

inspector, and Level B) for 8739.1, 8739.2, 8739.3, 8739.4, 8739.5, and J-STD-001 due to the fact that a vision acuity requirement is a prerequisite.

Equipment shall be provided as needed to demonstrate the practical exercises and for the students to perform the practical exercises. Calibration of equipment is required only to the extent needed to maintain and operate the equipment in a way that does not prevent students from successfully completing the course. The contractor may elect to use the GFE equipment shown in Table 5-1. This equipment shall be transferred back to GSFC when it is not longer used or useable in conformance with GSFC property transfer and inventory processes.

All consumable materials shall be provided by the contractor including items needed for the practical exercises, materials required to operate the equipment, training cards, and paper-based exams and workbooks. The practicum exercises are defined in Attachment 4.

5.7 Reporting. Reports shall be provided monthly containing the following as a minimum for each student:

a. Student's name
b. Student's organization (Branch Code for GSFC, CDM for Canadian Ministry of Defense, Company for all others)
c. Course taken
d. Whether the course was passed or failed
e. Tuition charged
f. Course dates (start and finish)

The following data shall be reported yearly:

a. GFE equipment received during that year
b. GFE equipment returned during that year

5.8 Billing. The contractor shall invoice GSFC for all tuition costs for GSFC civil servants and Canadian Ministry of Defense personnel. Tuitions for all other students shall be collected directly by the contractor from the students' organizations.

Table 5-1 GSFC Training Center Equipment

Item Name	Manufacturer	Model #	Qty
AIR GAUGE DISPENSER	EFD PHOTODYNE INC SUB OF	1000DV	2
BAG CHECKER	3M, MINN MINING & MFG.	705	1
BATH	BRANSON CORP	B2200R-1	2
BLAK RAY LAMP	FISHER SCIENTIFIC CO.	UVL-56	1
BLOCK CoPLANARY			4
CABINET, SUPPLY, 2 DOOR			1
CALIPER DIGITAL	MITUTOYO, TOKYO, JAPAN	500351	1
CAMERA VIDEO MICROSC	MICROIMAGE VIDEO SYSTEMS		1
CAMERA, TELEVISION	JAVELIN ELECTRONICS/ELECTRONIC	JE3262	1

Item Name	Manufacturer	Model #	Qty
CART, ROLLING, 3 SHELVES			1
CENTRIFUGE	COLE-PARMER INSTRUMENT CO.	17250-10	1
CHAIR, ROLLING, PADDED			17
CONTINUOUS MONITOR	IHI	9001-.5/	6
CRIMP TOOL	IDEAL INDUSTRIES INC. DANIEL		1
CRIMP TOOL	DANIELS MFG. CO. Cannon ITT	M22520/5	4
CRIMP TOOL GAGE PIN	DANIELS MFG. CO.	M22520/3	1
DESOLDERING STATION	PACE INC	PPS101SR	3
DISK DRIVE UNIT	APPLE COMPUTER INC	G7287	1
DISPLAY UNIT / TV	PANASONICS	2052R	1
DRIVE UNIT, OPTICAL	NEC AMERICA INC	4XE	1
DRY BOX	BOEKEL		1
DUPLICATING MACHINE	O K INDUS F-O K MACHINE & TOOL	SSP75A	2
DUROMETER	SHORE INSTRUMENT & MFG. CO.	SHORE A	1
DUROMETER	SHORE INSTRUMENT & MFG. CO.	SHORE D	1
ESD AUDIT KIT	3M, MINN MINING & MFG.	PAK-200	1
FIBER OPTICAL SYSTEM	NOYES, LEW F JR.	OPM5-2	1
FIBERSCOPE	BUEHLER EQUIPMENT CO	0801-950	4
FUSION SPLICER	FITEL	S177A	1
GAGE CONNECTOR	MAURY MICROWAVE CORP	299D007	2
GAGE FOR CRIMP TOOL	DANIELS MFG. CO.	NONE	3
GAGE, CONNECTOR	MAURY MICROWAVE CORP	A027	1
GAUGE FORCE	AMETEK INC.	T-10P-TC	1
HEAT CONTROL STATION	PACE INC	PPS101	2
HEEL GROUNDER	ESD SYSTEMS	24723	7
HYGROTHERMOGRAPH	DICKSON CO.	70418	1
HYGROTHERMOGRAPH	OMEGA INSTRUMENTS	CT485B	1
HYGROTHERMOGRAPH	DICKSON CO.	TH4	1
HYGROTHERMOGRAPH	DICKSON CO.	TH6	1
HYGROTHERMOMETER	ABBEON CAL INC F-ABRAX INSTR	HTAB-176	2
IONIZER AIR	SIMCO	4002612	1
IONIZER PERFORMANCE ANALYZER	MONROE	28722C	1
IONIZER, BENCHTOP	3M	963	2
IONIZER, SMALL, AIR	DESCO		1
KITS, FIBER OPTIC	OFCI TOOLKIT		2
LAMP			1
LAMP, MICROSCOPE	BUNTON CO		1
LAMP, MICROSCOPE	EXCEL TECHNOLOGIES INC		2
LAMP, UV	BLACK RAY	UVL-56	2
LAMP, UV			4
LAP TOP COMPUTER	3M PHOTODYNE INC SUB OF	5200 PT	1
LAPTOP COMPUTER	DELL, INSPIRON	6400	1
LAPTOP COMPUTER	TOSHIBA	2400-S201	1
LCD PROJECTOR	EPSON POWERLITE	EMP-51	1
LECTERN			1
LIGHT METER	AEMC CORP.	814	1
LIGHT, MAGNIFYING	LUXO	7121	21

Item Name	Manufacturer	Model #	Qty
LIGHTPACK, MULTIMODE	NOYES S/N J592A76	OPM4-2	2
MAGNIFIER HANDHELD	RAGLITE COIL	SERIES 2	1
MEGOHMMETER	3M	701	1
METER RESISTIVITY	WESCORP	WSRTG330	1
METER, ANALOG	SIMPSON ELECTRIC CO.	260-4	1
MICROSCOPE	BAUSCH AND LOMB INC	BVB73	1
MICROSCOPE	BUNTON CO	M3Z	6
MICROSCOPE	WILD HEERBRUGG AC	WILD-M8	1
MICROSCOPE	UNITRON INSTRUMENTS INC	ZSM	8
MICROSCOPE LAMP	EXCEL TECHNOLOGIES INC	FO-150	7
MICROSCOPE, DOUBLE	NIKON	SMZ10	1
MICROSCOPE, LIGHT	INTRALUX 5000, VOLPI AG	CH-8952	1
MONITOR DISPLAY UNIT	DELL COMPUTER CORP F-PC'S LTD	VC-10C	1
MONITOR TELEVISION	SONY CORP	KV2095	1
MONITOR TELEVISION	EMERSON ELECTRIC COMPUTER PWR	TC2555D	1
MONITOR UNIT	JAVELIN ELECTRONICS/ELECTRONIC	CVM-13C	1
MONITOR, WRISTSTRA	SPECTRA SCAN	SMU101A	1
MULTIMETER	FLUKE, JOHN MFG. CO. INC.	77	1
MULTIMETER, DIGITAL	FLUKE, JOHN MFG. CO. INC.	8022A	1
OPTICAL FIBER CLEAVER	FURUKAWA ELECTRIC CO.	S-315	3
OPTICAL FIBER KIT	OFCI TOOLKIT	NONE	1
OPTICAL FIBER MONITO	OPTICAL ELECTRONICS INC	OFM20	1
OVEN	FISHER SCIENTIFIC CO.	500	1
OVEN	VWR SCIENTIFIC	1310	2
PNEUMATIC DISPENSER	KANNETICS	KDS 834A	1
POLISHER / FIBER OPTIC	GCT S/N 01084	CT-9000	1
PRINTER ADP	MATSUSHITA ELEC INDUS CO	KXP1091	1
PROJECTION SCREEN	BRETFORD 200 MERCURY		2
PROJECTOR, SLIDE	HEWLETT PACKARD	HP6320	1
PROJECTOR, VIDEO	MEGAPOWER	ML-892	1
PULL TESTER	ALPHATRON INC.	MBT250B	1
PULL TESTER	ALPHATRON INC.	MPT200	1
RECORDER VIDEO	EMERSON ELECTRIC COMPUTER PWR	765N	1
RECORDER VIDEO CASS	SAMSUNG ELECTRONICS	VP2095	1
RECORDER, TEMPERATUR	DICKSON CO.	4JX99	2
RED TOOL BOX	HOMAK		4
RED TOOL BOX - BOTTOM	STACK ON		2
RED TOOL BOX - TOP	STACK ON		2
REFRIGERATOR	SANYO ELECTRIC CO LTD	SR-250X	1
SLIDE PROJECTOR CARO	KODAK CANADA LTD.	4600	2
SOLDER FLOW, SMT	AUSTIN AMERICAN	SS-620	1
SOLDER POT	PLATO PRODUCTS INC	SP500T	3
SOLDER STATION	WELLER DIV. THE COOPER GROUP	EC2001	1
SOLDER STATION	PACE INC	PPS25	8
SOLDER STATION	PACE INC	PPS400	1

Item Name	Manufacturer	Model #	Qty
SOLDER STATION	PACE INC.	ST-45	4
SOLDER STATION	PACE TEMPWISE	TW100	8
SOLDERING MACHINE	JAPAN JPL LAB., INC.	RF-330	1
SOLDERING-IRON	WELLER DIV. THE COOPER GROUP	EC2002	2
SPRAY GUN	BINKS	115	1
STATIC METER	ANDERSON	DCA-1200	1
STATIC SENSOR	3M, MINN MINING & MFG.	709	3
STATIC SENSOR	3M	718	2
STRIPPER THERMAL	E P E CORP	875	8
STRIPPER,WIRE	IDEAL INDUSTRIES INC. Stripmaster	5211	3
STRIPPER,WIRE	IDEAL INDUSTRIES INC. Stripmaster	5560	5
STRIPPER,WIRE	IDEAL INDUSTRIES INC.	45-181	4
STRIPPER,WIRE	IDEAL INDUSTRIES INC. Stripmaster	L5211	5
STRIPPER,WIRE	IDEAL INDUSTRIES INC. Stripmaster	NONE	2
STRIPPER,WIRE	IDEAL INDUSTRIES INC. Stripmaster		1
STRIPPER,WIRE, THERMAL	PATCO	PTS-30	10
SWAGING MACHINE	CAMBION	NONE	2
SYSTEM, PICK AND PLA	O K INDUS F-O K MACHINE & TOOL	SMT881	1
TEMP. DATA LOGGER	DICKSON CO.	SM150	1
TESTER, HI-POT	TOROTRON	THP07DA	1
TESTER, WRIST STRAP	WESCO MFG CO	WSC 110	12
THERMOMETER		60DEG-C	2
THERMOMETER	TEL-TRU MFG. (ROCHESTER, N.Y.)	AD10-R	2
THERMOMETER	OMEGA INSTRUMENTS	HH82	1
TOOL CRIMP	DANIELS MFG. CO.	AF8	6
TOOL CRIMP	DANIELS MFG. CO.	AFM8	8
TOOL CRIMP	DANIELS MFG. CO.	CCT-TM	1
TOOL CRIMP	DANIELS MFG. CO.	M22520/1	11
TOOL CRIMP	M/A-COM OMNI SPECTRA INC	T-4718	8
TOOL, CONTACT RETENT	RUSSTECH	RTCRT-16	2
TOOL, CONTACT RETENT	RUSSTECH	RTCRT-20	2
TOOL, CONTACT RETENT	RUSSTECH	RTCRT-22	2
TORQUE WRENCH	STURTEVANT RICHMONT	569938	1
TORQUE WRENCH	STURTEVANT RICHMONT	578202	1
TORQUE WRENCH	MOUNTZ, D. G. ASSOCIATES, INC.	TB100C	4
TV STAND			3
VACUUM PUMP	PRECISION SCIENTIFIC INC	D25	1
VACUUM, WET/DRY	DAYTON ELECTRIC MFG CO	1D457	1
VaporPhaseReflowSys	CENTECH CORP.	VP1000	1
VHS Recorder (s/b excessed)	PANASONICS	AG170	1
VIEWGRAPH PROJECTOR	PORTA SCRIBE		1
VISCOSIMETER	BROOKFIELD ENGINEERING LABS	RVDVI	1
VOLTOHMMETER	ASSOCIATED RESEARCH	2026D	1
WORKBENCH	LINEMASTER 23.5" X 121"		9
WORKSTATION GROUNDING KIT	3M	8034	2
WRIST STRAP CHECKER	CHARLES WATERS	CP903A	1
WRIST STRAP METAL (MED)	3M	2382	8

Item Name	Manufacturer	Model #	Qty
WRIST STRAP MONITOR	3M	724	4
WRIST STRAP MONITOR	PILGRIM	GAM16	2
WRIST STRAP MONITOR	SIMCO	M50A	1
WRIST STRAP TESTER	3M, MINN MINING & MFG.	745	1
WRIST STRAP TESTER	WESCORP	B767	4
WRIST/HEEL STRAP TESTER	ACL	780	2

Attachment 1: NASA Policy Requirements for Workmanship Standards Training Programs

A.1 General

This section:

a. Establishes the training and certification requirements for workmanship operators, inspectors, and instructors.

b. Establishes training requirements for NASA use of IPC J-STD-001ES and ANSI/ESD S20.20.

c. Establishes requirements for implementing NASA Workmanship Training Centers to assure that successful completion of the courses by workmanship operators, inspectors, and instructors results in a common knowledge baseline among those personnel, and that common and predictable student processing practices are applied.

A.1.1 NASA Level A Training Centers have been designated at NASA Goddard Space Flight Center (GSFC) and the Jet Propulsion Laboratory (JPL) for the purposes of providing master training sites for the dissemination of training for all levels of NASA Workmanship students, including Level B instructors. The terms and requirements included herein relative to NASA Level A Training Centers do not apply to courses specifically designed for GSFC or JPL use.

A.1.1 NASA Level B Training Centers have been designated at NASA Johnson Space Center (JSC) and NASA Marshall Space Flight Center (MSFC) for the purpose of providing access to local training resources by JSC personnel, MSFC personnel, on-site support contractors, and DCMA personnel for NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, and NASA-STD-8739.5 courses. The terms and requirements included herein relative to NASA Level B Training Centers do not apply to courses specifically designed for JSC or MSFC use.

A.2 Workmanship Certified Personnel

A.2.1 The following personnel are required to be Workmanship Standards certified:

a. Operator or Certified IPC® Application Specialist (CIS): builds and inspects printed wiring assemblies, cables, and cable harnesses (electrical).

b. Inspector or CIS-inspector: inspects printed wiring assemblies, cables, and cable harnesses (electrical) for defects in accordance with workmanship standard requirements.

c. ESD operator and ESD program monitor: receives training for handling ESD sensitive hardware or for performing special duties relative to ESD controlled area certification. The local ESD control implementation plan may define alternative names for these roles.

d. Level B instructor: trains operators and inspectors to NASA workmanship standards 8739.1, 8739.2, 8739.3, 8739.4, and 8739.5. Suppliers and NASA Centers may choose to use a Level B instructor designation for ESD training (see paragraph A.12.14).

(1) Level B instructors employed in a NASA Level B Training Center may train:

- Operators and inspectors who are employed by their sponsoring NASA Center either as civil servants or on-site contractors.
- Prime contractors under direct contract to the NASA Center from which the training is being obtained.
- Subcontractors under contract to prime contractors described above
- Defense Contract Management Agency (DCMA) personnel working to a NASA letter of delegation.

(2) NASA Level B instructors who work at a NASA Center but not in a NASA Level B Training Center may train:

- Operators and inspectors who are employed by their sponsoring NASA Center either as civil servants or on-site contractors.

(3) Level B instructors employed in a Level B Supplier Training Program may train:

- Operators and inspectors who are employed by the instructor's company.
- Operators and inspectors who work for companies contracted to their company (i.e., subcontract to NASA).

(4) Level B instructors employed in a Level B Supplier Training Program are not permitted to train students from organizations to which the instructors' organization delivers mission hardware.

e. ESD Instructor: instructs ESD operators, ESD program monitors, and local instructors to the local ESD control implementation plan traceable to ANSI/ESD S20.20.

f. Certified IPC® Trainer (CIT): trains operators and inspectors inside or outside of their own company.

g. Level A instructor: trains all operators, inspectors, and Level B instructors inside and outside of their own company to NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, and NASA-STD-8739.5.

h. Certified IPC® Master Trainer (CIM): trains CIS's and CIT's inside or outside of their own company.

A.2.3 Training of personnel to NASA workmanship standards and IPC® standards is specific to the student type (e.g., operator, inspector, instructor, CIS-operator, CIS-inspector only). Individuals who desire dual certification as an operator and an inspector for the NASA

workmanship standards shall make special arrangements with their instructor to take a training program(s) that result in dual certification.

A.2.4 CIS training using the IPC J-STD-001ES non-modular course results in dual operator/inspector training except if inspector-only training is requested. Certified workmanship instructors shall be permitted to also perform the duties of certified operators and certified inspectors. Certifying authorities are responsible for ensuring that operators and instructors, when performing these additional duties, are competent to perform work that may not be their usual assignment. Certified workmanship personnel shall not inspect their own work.

A.2.5 Where training is performed using primarily computer-based material without the presence of an instructor (e.g., on-line, SATERN, CD-based), the policies described herein relative to the certification and responsibilities of trainers, do not apply. See paragraphs A.9.25 and 9.C.5 for limitations on the use of computer-based training.

A.3 Responsibility for Personnel Certification

A.3.1 Suppliers who are required to comply with one or more of the workmanship standards in Table 1-1 are responsible for ensuring that all operators and inspectors in their company who manufacture NASA mission hardware are capable of performing their tasks in a way that complies with the requirements of the workmanship standards and in a way that results in compliant product. Suppliers who employ Level B instructors are responsible for ensuring that the Level B instructors have a sufficient mastery of the course content they teach, have the appropriate teaching skills to properly instruct students, and have sufficient ability to assess their students' mastery of the subject matter. Evidence that operators, inspectors, and instructors are able to meet workmanship requirements is required in the form of a supplier certification (except Level A instructors, see paragraph A.3.7).

A.3.2 The minimum requirements for supplier-awarded workmanship certification are found in paragraphs A.5 and A.6 below. Additional certification criteria may be applied at the supplier's discretion. Personnel who no longer meet one or more of the minimum criteria for certification shall have their certification revoked by the supplier.

A.3.3 The supplier shall apply local policies for reinstating the certification of operators who fail to meet the minimum requirements for competency and work period interruption, but not for failure to meet retraining requirements. Local policies may employ retraining and other methods (e.g., mentoring) to ensure that inactive or ineffective personnel can demonstrate the required competency and knowledge of the requirements.

A.3.4 Local policies shall be documented and maintained under configuration change control.

A.3.5 The certifying authority for Level B instructors who teach in a NASA Level B Training Center is the NASA Level B Training Center Lead.

A.3.6 Suppliers who are required to comply with IPC J-STD-001ES are responsible for ensuring that all CITs and MITs used by their organization to train CISs carry valid IPC® certifications as a minimum. Additional certification criteria may be imposed by the supplier at the supplier's discretion.

A.3.7 The NASA Workmanship Standards Program is responsible for certifying Level A Instructors who teach operator, inspector, and Level B instructor courses for NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, and NASA-STD-8739.5. Responsibility for the certification of Western NASA Manufacturing Technology Transfer Center (W-NMTTC) Level A instructors may be delegated by the NASA Workmanship Standards Program Manager to the W-NMTTC Training Center Manager.

A.3.8 Portability of Workmanship Training

a. NASA workmanship standards training, except ESD training, obtained from a Level A or NASA Level B Training Center is transferable and valid for work performed at all NASA supplier facilities (i.e., portable).

b. When using IPC training courses for J-STD-001ES training, it is the supplier's decision whether to use the modular or the non-modular course. Either is considered acceptable for meeting NASA quality assurance requirements which specify J-STD-001ES. The non-modular course is not considered equivalent to the modular course (it is a subset) and will not satisfy contracts invoking IPC J-STD-001E Class 1, Class 2 or Class 3.

c. IPC J-STD-001ES training, using either the IPC modular course or the non-modular course, shall be treated as portable between suppliers.

d. Supplier-custom IPC J-STD-001ES training shall not be treated as portable between suppliers. Early retraining after change of employment may be required if the prior training did not include the full requirements set.

A.3.9 Portability of NASA Workmanship Certification.

a. NASA Workmanship Certification is not portable between suppliers for operators, inspectors, non-IPC® instructors, and ESD program monitors. NASA workmanship certifications for these personnel shall be revoked when employment is terminated.

b. A change of employer requires the new employer to recertify the newly hired individual.

c. Employers who are the workmanship certifying authority for operators, inspectors, and Level B instructors may choose to send new employees to retraining.

A.3.10 NASA Workmanship Certification is not required for IPC J-STD-001ES certified instructors (i.e. CIT and MIT). IPC® CIT and MIT certifications are fully portable between suppliers.

Certification to the Modular IPC J-STD-001ES training for operators and CISs shall not be used as the sole justification for NASA workmanship certification (Requirement). See paragraph A.5 for NASA Workmanship Certification requirements for operators and inspectors.

A.4 Certification Records

A.4.1 Certification records shall be retained by the supplier for a minimum of five years.

A.4.2 Evidence of certification status shall be maintained in the work area.

A.5 Minimum Certification Requirements for Operators, Inspectors, and ESD Program Monitors

A.5.1 All operators, inspectors, and ESD program monitors shall be certified a minimum of once every two years. Minimum certification requirements for workmanship operators, inspectors, ESD operators, and ESD program monitors are as follows:

a. Retraining every two years from:

(1) A Level A or NASA Level B instructor for NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, and NASA-STD-8739.5.

(2) A CIT or MIT for IPC J-STD-001ES.

(3) A locally certified Level A or Level B ESD instructor for the local ESD control program.

b. Achievement of vision requirements per paragraph A.7 (not required for ESD).

c. Continuous competency.

d. No more than a six month absence from performing related duties (not required for ESD).

A.6 Minimum Certification Requirements for Instructors

A.6.1 Workmanship instructors shall be certified every two years.

A.6.2 Minimum certification requirements for Level B instructors and ESD instructors who do not work in a NASA Level B Training Center are as follows:

a. Biennial training at the instructor level from a Level A instructor for NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, or NASA-STD-8739.5 or per A.6.3 for ESD.

b. Achievement of vision requirements per paragraph A.7 (except ESD).

c. Continuous competency.

d. No more than a six month absence from teaching a NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, NASA-STD-8739.5, or and ESD course.

A.6.3 The local organization (i.e., NASA Center or contractor) that owns the applicable ESD control plan to which the training is traceable shall:

a. Retain the authority for defining the training program requirements.

b. Retain authority for when and how an ESD Level A/ESD Level B instructor hierarchy may apply.

A.6.4 Minimum certification requirements for Level B instructors or ESD instructors who work in a NASA Level B Training Center are as follows:

a. Formal review of all updates to NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, NASA-STD-8739.5, and the local ESD control implementation plan.

b. Biennial training at the instructor level from a Level A instructor for NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, or NASA-STD-8739.5, or per A.6.3 for ESD. Successfully passing an audit by a civil service NASA Level B instructor every two years is acceptable in lieu of training.

c. Achievement of vision requirements per paragraph A.7 (except ESD).

d. Continuous competency.

e. No more than a six month absence from teaching a NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, or NASA-STD-8739.5 course.

A.6.5 Minimum certification requirements for Level A instructors are as follows:

a. Formal review of all updates to NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, and NASA-STD-8739.5.

b. Achievement of vision requirements per paragraph A.7 (except ESD).

c. Continuous competency.

d. No more than a six month absence from teaching a NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, or NASA-STD-8739.5 course.

A.6.6 Proficiency based on hands-on experience is expected for all Level A and Level B Instructors.

A.7 Vision Requirements

A.7.1 The supplier is responsible for ensuring that all personnel intended for Workmanship Certification meet vision test requirements. Vision screening is a prerequisite for initial training and retraining . Vision testing is not required for ESD training or ESD certification.

A.7.2 Vision requirements may be met with corrected vision (eyeglasses or contact lenses).

A.7.3 Vision tests shall be administered a minimum of once every two years by a qualified examiner using standard instruments and techniques.

A.7.4 Results of the visual examinations shall be made available to training centers when students register for workmanship training.

A.7.5 Following are minimum vision requirements:

a. Near Vision. Jaeger 1 at 355.0 mm (14 inches), reduced Snellen 20/20, or equivalent.

b. Color Vision. Ability to distinguish red, green, blue, and yellow colors as prescribed in Dvorine Charts, Ishihara Plates, or AO-HRR Tests. A practical test using color coded wires or electrical parts is acceptable for color vision testing.

A.8 Safety Statement from NPD 8730.2, Attachment A, Subparagraph d.

A.8.1 The use of lead (Pb) containing solders presents an employee exposure hazard that is regulated under OSHA (29 CFR 1910.1025). This regulation requires that baseline hazard assessments be performed for any operation (e.g., generation of metal dust or fume) that may result in employee exposure to lead, and additional medical surveillance, employee training, monitoring, and exposure control requirements applied when a positive exposure assessment is made. Exposure risk, based on past assessments, is very low for piecework operations and moderate for assembly line or classroom instruction based on work volume.

A.8.2 Regardless of the exposure assessment outcome, all affected employees are required to complete Hazard Communication training for Chemical Users and review of 29 CFR 1910.1025, Appendix A, "Substance data sheet," and B, "Employee Standard Summary." This training may be provided at the supervisory level by employee review of the referenced appendices.

A.8.3 Additionally, all soldering workstations require use of local exhaust ventilation (fume extractors) and regular cleaning to prevent buildup of lead residue on work surfaces.

A.9 General Training Program Requirements for NASA Workmanship Standards

A.9.1 NASA workmanship training for NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, and NASA-STD-8739.5 is intended for NASA Center employees, NASA prime contractors and their subcontractors, and DCMA employees. This training is not intended for employees of commercial entities or foreign nationals who are not sponsored by the US Government or who are not currently in a contractual relationship with NASA (either directly or via subcontract).

A.9.2 Vision screening shall be performed within 23 months of the date of the start of training or retraining as a prerequisite for NASA Workmanship Standards training . ESD training is exempted from this requirement.

A.9.3 Personnel who have never taken training for use of the NASA Workmanship Standards shall take the initial training course. See Table A-1 and paragraph A.12.13 for the recommended duration and minimum content requirements for the baseline course.

A.9.4 Personnel who take and pass the initial training course or the retraining course shall be awarded evidence of successful completion of training by the instructor such as in the form of a certificate, wallet-sized card, or electronic record.

A.9.5 When training completion records are issued, it shall be clearly stated that the record is not a substitute for evidence of certification.

A.9.6 Personnel who are repeating training within twenty-seven months of taking the initial training course may take a shortened retraining class. Personnel who take and pass a retraining course shall be provided evidence of successful completion of training by the instructor.

A.9.7 Operators, inspectors, and Level B instructors who fail to enroll and complete the retraining course within twenty-seven months of taking the initial training course forfeit the option to take the shortened class for retraining. See Table A-1and paragraph A.12.13 for the recommended duration for retraining courses.

The training center may use their own internal, documented procedures to consider and grant exceptions to this requirement, however, a failure to repeat training within twenty-seven months of the prior training is considered a non-compliance with Workmanship Certification requirements and shall result in revocation of the individual's certification.

A.9.8 Operators, inspectors, and Level B instructors with current training from a NASA Level A or NASA Level B Training Center (not greater than 27 months has passed since training was completed) shall be granted access to retraining classes, on a first-come, first-served basis, at either of the two Level A Training Centers.

A.9.9 The curriculum of the initial training course or the retraining course may be expanded to meet local needs. The training completion record shall clearly indicate that the student successfully completed training for the applicable standard. Indications on the training record which are applicable to the added material may be added at the instructor's or supplier's discretion.

A.9.10 The curriculum of the initial training course or the retraining course may be reduced where the students will not perform work in certain areas. The training record and training completion record shall detail the limits of the training by identifying the training as partial and by either specifying the included material or by specifying the excluded material.

A.9.11 The curriculum for operators and inspectors shall be identical.

A.9.12 Training programs may choose to test operators and inspectors differently so that inspectors are not penalized for not possessing hands-on skills which apply only to operators. However, all students shall participate in ungraded hands-on demonstrations and exercises.

A.9.13 All instructor students shall be trained and tested to the level of operator, inspector, and instructor.

A.9.14 The evidence of successful completion of training shall contain the following information as a minimum:

a. Student's name.

b. Course name, with exclusions or inclusions as applicable.

c. Training level: operator, inspector, instructor (instructor training completion documents are only provided by a NASA Level A Training Center, by a Level A ESD instructor, or by an IPC MIT).

d. Completion date.

e. Instructor's name.

f. Instructor's organization such as the training center name or the supplier name.

A.9.16 The instructor or the instructor's organization shall maintain training records for all students they have trained for a minimum of five years.

A.9.17 Training equipment does not require regular calibration, however, it shall be maintained and checked in a manner that ensures that students are able to obtain normal results using the

recommended techniques, and are not prevented from successful course completion due to underperforming classroom equipment or supplies.

A.9.18 Expired calibration stickers shall not be left on equipment that does not require calibration. When expired calibration stickers are used as teaching aids, they shall be identified in advance to auditors performing institutional-level quality audits.

A.9.19 A training package including the instructional slide program and all paper tests and quizzes will be made available to all Level B instructors following successful completion of training. Level B instructors may use these training materials with or without modification or augmentation.

A.9.20 Training program curriculum and materials which are developed solely by the supplier and used by Level B instructors, CITs, and MITs at supplier facilities which are not NASA Training Centers shall be made available to NASA programs and projects for review and approval upon request.

A.9.21 Workmanship training programs for NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, NASA-STD-8739.5, and supplier-created IPC J-STD-001ES training programs shall:

a. Document the methods and procedures proposed to fulfill the requirements of this standard.

b. Utilize visual standards consisting of satisfactory work samples or visual aids that clearly illustrate the quality characteristics relevant to the applicable workmanship standard. Examples of unacceptable conditions may also be used for clarification or comparison.

c. Make applicable standards readily available.

d. Not duplicate IPC® copyrighted material.

A.9.22 Workmanship training program documentation shall include, as a minimum:

a. Procedures for training, including who will be trained and for what purpose, (e.g., operator, inspector).

b. Lesson plan(s)/student workbook.

c. Hours of instruction.

A.9.23 Supplier workmanship certification process documentation shall include, as a minimum:

a. Procedures for certification and recertification.

b. Procedures for recording training, recertification, and method of identifying/recalling trained personnel.

A.9.24 Personnel certification shall be reviewed for impact when a supplier training program fails to meet requirements set forth herein. Retraining from an alternate source may be required to meet the certification requirements.

A.9.25 Initial training courses, except for ESD control, shall not be primarily computer-based courses without the use of an instructor.

A.9.26 Retraining courses may use computer-based content, however, they shall also include practical/ hands-on content that has been evaluated by a certified instructor.

A.9.27 Long-distance-learning retraining programs that deliver tests and practical exams to remotely located students and then evaluate the exams using certified instructors in another location (completed tests and boards shipped to instructor) are allowed. The supplier is accountable for the effectiveness of computer-based or distance-learning arrangements.

A.9.28 Validation of the effectiveness of computer-based or distance-learning arrangements is demonstrated through the supplier's certification of the operator, inspector, or Level B instructor who successfully completed that training (also see A.9.20).

A.10 Training Program Requirements, NASA Training Centers

A.10.1 NASA Training Centers (Level A and Level B) shall have NASA civil service management oversight to assure compliance by the training center with the requirements of this document.

a. This individual is referred to as the NASA Training Center Lead and shall act as the liaison between the NASA Workmanship Standards Program Manager and their assigned training center on matters of policy interpretation and flow down.

b. The role of the NASA Training Center Lead for the Western NASA Manufacturing Technology Transfer Center (W-NMTTC) may be delegated by the Workmanship Program manager to a JPL employee who has direct responsibility for the successful operation of the facility and for implementation of the training programs.

c. The W-NMTTC training center lead shall be the primary point of contact for the W-NMTTC for the NASA Workmanship Standards Program Manager.

d. The W-NMTTC training center lead shall be responsible and accountable for compliance by the W-NMTTC with the requirements herein.

e. The NASA Workmanship Standards Program Manager shall be responsible and accountable for compliance by the Eastern NASA Manufacturing Technology Transfer Center (E-NMTTC) with the requirements herein.

A.10.2 The NASA Training Center Lead shall ensure that all Level A and NASA Level B instructors are provided current information disseminated by the NASA Workmanship Standards Program Manager that impacts workmanship policy, training, and curriculum (Requirement).

A.10.3 The instructors shall be required by the NASA Training Center Lead to formally review updates to NASA Workmanship Standards.

A.10.4 NASA Training Centers shall have a method by which they can ensure that students enrolled in Workmanship standards courses are only those individuals who comply with the visual acuity requirements herein (see A.7).

A.10.5 A yearly activity report shall be delivered by the NASA Training Center Lead to the NASA Workmanship Standards Program Manager which describes the number of students trained and the number and types of NASA Workmanship Standards courses taught for the report year.

a. These yearly reports shall include as a minimum:

b. The name of each Workmanship course given (NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, or NASA-STD-8739.5)

c. The number of students who attended each course.

d. Breakdown for students between civil service and contractors.

e. The number of students who have passed and the number of students that have failed the classes in the reporting period.

A.10.6 The NASA Level A Training Centers are the following:

a. GSFC
NASA's Manufacturing Technology Transfer Center (NMTTC) Eastern Region
Code 300.1
Greenbelt, MD 20771
(410) 964-7616

b. JPL
NASA's Manufacturing Technology Transfer Center (NMTTC) Western Region
MS83-204
4800 Oak Grove Drive
Pasadena, CA 91109
(818) 354-6730

A.10.7 Students seeking training for NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, or NASA-STD-8739.5 who are not directly affiliated with NASA by employment, by contract, or by U.S. Government agreement may be accepted into a NASA Workmanship training class at a NASA Level A Training Center only by approval by the NASA Workmanship Standards Program Manager.

A.10.8 NASA Level B Training Centers shall not provide NASA Workmanship training to students who are not affiliated with their NASA Center (See A.1.1).

A.10.9 Foreign nationals shall not be enrolled in a NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, or NASA-STD-8739.5 course at a NASA Level A or NASA Level B Training Center unless a TAA (Technical Assistance Agreement) is drawn up between that Training Center, the foreign company or governmental organization, and the U.S. State Department.

In addition, NASA Headquarters approval is required for training which lasts longer than 14 days or if the enrollee is from a designated country (as determined by the U.S. State Department).

A.10.10 All NASA Level A and Level B Training Centers shall provide ready access to:

a. course offerings.

b. schedules, including start and stop times.

c. course descriptions.

d. course prerequisites including:

(1) required visual acuity testing prior to course attendance.

(2) limitations on enrollment in retraining classes based on date of last training (maximum time elapsed is 27 months, see paragraph A.9.7).

e. enrollment information including:

(1) course fees, payment requirements (timing, methods).

(2) rules and amounts applicable to financial penalties for cancelled reservations.

(3) registrar point of contact.

(4) rules on course attendance (e.g., lateness, missed time).

A.10.11 Advertising content shall include a description of the target audience and practical experience level of the typical passing student to make clear to interested parties, what experience is needed for this training. Schedule information should include encouragements to the students to sign up for courses three months in advance of their need.

A.11 IPC® J-STD-001ES Training

The IPC® J-STD-001ES training program is designed and controlled by the IPC®. IPC® J-STD-001ES training materials may be augmented but not modified due to copyright limitations. Acceptable IPC® J-STD-001ES training for NASA Workmanship certification is described in Section 9.C herein.

A.12 Courses

A.12.1 Course material shall accurately and completely represent the requirements statements in the applicable standards.

A.12.2 For courses where each requirement cannot be directly covered due to time constraints, the course content shall combine overviews of less critical areas, provide more detailed coverage of the critical topics, and facilitate all students being able to find all of the applicable requirements in the standard.

A.12.3 Suppliers may design workmanship courses to neglect entire topic areas that are not used by their staff. If whole topic areas are absent from the training, it shall be made clear to the students and shall be represented in the training completion certificate, preferably by paragraph number.

Note: Using NASA-STD-8739.1 as an example, if bonding is not covered, the training certificate shall note "except Bonding per Section 11".

A.12.4 Requirements above and beyond those included in the NASA standards may be taught but must be identified as auxiliary to the NASA Standards baseline. Incorrect answers to test questions, and failure of students to demonstrate practical skills which are not directly related to requirements found in the relevant NASA Workmanship Standard, shall not be considered when assessing the student's successful completion of the NASA Workmanship Standards courses for NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, and NASA-STD-8739.5.

A.12.5 Course content shall consist of lectures, practical exercises, quizzes, and exams which accomplish the following:

a. Describe and interpret the technical requirements in the standard.

b. Reference the location of each of the technical requirements.

c. Demonstrate the method for achieving compliant assembly features (i.e., solder joints, contact crimps, polymer coating layers, etc.).

d. Demonstrate the student's ability to achieve compliant features and/or recognize disallowed defects.

e. Assess the student's retention and understanding of the requirements.

f. Assess Level B instructor candidates' abilities to teach the material.

A.12.6 When the course is intended for use for training or retraining Level B instructors, course material shall include special topics relative to instructor requirements .

A.12.7 All other students shall not be tested to the instructor requirements.

A.12.8 Class time shall be provided to the Level B instructor students to allow them to demonstrate adequate instructor skills.

A.12.9 Course content shall be available for review and approval by the NASA Workmanship Standards Program Manager and/or the Level B Training Center Lead.

A.12.10 Course content deemed inappropriate or insufficient by the Workmanship Standards Program Manager or the Level B Training Center Lead shall not be used.

A.12.11 Courses shall be limited to teaching only one NASA Standards document. Overview classes which introduce the content of several or all of the NASA Workmanship Standards are not within the scope of this policy.

A.12.12 NASA Level A Training Centers shall be able to provide all training courses for NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, and NASA-STD-8739.5 as a minimum. NASA Level B Training Centers have the option to provide only those courses which are required by their student body.

A.12.13 The recommended course lengths for the NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, and NASA-STD-8739.5 courses (slide package, practical exercises and exams, written exams and quizzes) are shown in Table A-1.

Table A-1 Recommended Course Lengths

Course	Initial Training Class Duration Operators & Inspectors	Instructors	Re-training Class Duration
Polymeric Operations (Operators), per NASA-STD-8739.1	32 hours	40 hours	16 hours
Polymeric Applications (Inspectors) per NASA-STD-8739.1	8 hours	N/A	8 hours
Surface Mount per NASA-STD-8739.2	32 hours	40 hours	16 hours
Hand Solder per NASA-STD-8739.3	36 hours	56 hours	16 hours
Crimp, Cable & Harness per NASA-STD-8739.4	36 hours	56 hours	16 hours
Fiber Optics per NASA-STD-8739.5	32 hours	56 hours	16 hours

Note: There is no NASA-wide training program for ESD control because all students must be trained in accordance with the local implementation plan used in the facility in which they will operate (see ANSI/ESD S20.20). NASA Level A and Level B Training Centers may choose to offer a Level B training program internally for ESD to enable their on-site personnel to meet training cost and schedule needs.

A.13 Student Requirements

A.13.1 The NASA Workmanship Standards training classes are intended for personnel seeking one or more of the certifications described in paragraph A.2 (except Level A instructor). This training is not intended or designed to teach basic electronic assembly and manufacturing skills such as basic soldering skills.

A.13.2 Level B instructor students shall successfully demonstrate the requisite skill needed to demonstrate the practical exercises.

A.13.3 All students shall be required to provide evidence to the NASA Workmanship Training Center of a current visual acuity assessment which meets the requirements of paragraph A.7.

a. Current is defined as having been completed within the prior 23 months.

b. Students who are not able to supply this evidence shall not be allowed to participate in the class.

A.13.4 For NASA-STD-8739.1, NASA-STD-8739.2, NASA-STD-8739.3, NASA-STD-8739.4, and NASA-STD-8739.5 courses, students shall be evaluated on the basis of written and practical tests (Requirement).

a. A passing grade for written exams shall be 80% and above.

b. A passing grade for the practical exams shall be 85% and above.

c. Written and practical scores shall not be averaged.

d. To pass the class, the student shall pass both the written and the practical exams.

e. The IPC® establishes the testing and scoring requirements for the IPC® J-STD-001ES courses. For the local ESD courses, the NASA Center or supplier establishes the testing and scoring requirements.

A.13.5 A student shall not be allowed to attend a class if they are absent or late thereby missing -more than 10% of the overall class time, or if the time missed is considered detrimental to the required level of training by the instructor.

a. If the student's lateness or absence has been deemed detrimental, the student shall be dismissed from class and will have to re-enroll.

b. A dismissed student forfeits all course costs.

A.14 Enrollment

A.14.1 Students shall be able to enroll in Workmanship Standards courses by mail, email, phone, or fax.

A.14.2 See Section A.9 above for timing restrictions associated with registering for retraining courses and A.13.3 for expiration limits on vision test results. Current vision test results are a prerequisite for Workmanship training.

A.14.3 Students who have taken their prior class (full class or retraining) at another NASA Training Center (W-NMTTC, E-NMTTC, or NASA Level B Training Center) or from a Level B instructor not connected with a NASA Training Center, must produce evidence of successful completion of the prior class and the name of the instructor. Prior to enrollment the evidence provided must be analyzed to ensure that the prior training was not a limited training course per A.12.3 and was obtained from a valid source. Level B Instructors must have been trained by a Level A Instructor or certified by the NASA Training Center Lead.

A.15 Applicability of Training

A.15.1 Students who pass classes given at a NASA Level A or Level B Training Center meet the training portion of the certification requirements of the applicable NASA Workmanship Standards for the duration of twenty-seven months following course completion, and can apply that certification to their work done on behalf of any NASA Center or NASA contract.

A.15.2 Students who take and pass a Workmanship Standards training course where portions of the requirements are not taught, and those portions are noted on the training completion

certificate or card, are not permitted to perform those functions (as an operator or inspector) on NASA mission hardware. This policy applies regardless of the source of training (NASA Training Center or from a supplier's Level B Instructor).

ATTACHMENT 2: Course Descriptions

1. For NASA-STD-8739.1, Polymeric Applications

Course Names from Table 2-2a and 2-2b:
8739.1 Operator Initial, course duration: 4 days
8739.1 Operator Re-training: 2 days
8739.1 Level B Instructor Initial: 5 days
8739.1 Level B Instructor Re-training: 2 days
8739.1 Inspector Initial or Re-training: 1 day

These courses provide instruction to those who are responsible for applying polymeric materials to electronic assemblies or for inspecting those applied materials per NASA-STD-8739.1, Polymeric Applications. Topics include staking, conformal coating, potting, and bonding. All of the requirements contained in the standard are discussed. The curriculum uses a slide presentation, a student workbook, practical exercises, quizzes and exams. Practical exercises include demonstrating techniques for these polymeric material applications and demonstration of students' competency for using these techniques in a manner that produces hardware that meets the requirements of the standard. The criterion for student success in the practical exercises is determined based on the level of certification sought: inspector or operator. Additional classroom time and demonstration of teaching capability are required in the instructor course. A significant portion of the course material is identical for the three Initial training levels enabling students to be grouped together for most parts of the Initial training courses. Retraining courses for operators, inspectors, and instructors are overviews of the information provided in the corresponding Initial course. Course durations are shown above. These courses are a prerequisite for NASA-STD-8739.1 operator, inspector and instructor certification.

2. For NASA-STD-8739.2, Surface Mount Technologies (Soldering)

Course Names from Table 2-2a and 2-2b:
8739.2 Operator/Inspector Initial, course duration: 4 days
8739.2 Level B Instructor Initial, course duration: 5 days
8739.2 Operator/Inspector Re-training, course duration: 2 days
8739.2 Level B Instructor Re-training, course duration: 2 days

These courses provide instruction to those who are responsible for using surface mount soldering systems for assembling printed wiring assemblies per NASA-STD-8739.2, Surface Mount Soldering. Topics include material selection, parts and material quality assurance and preparation, pre-assembly inspections, and solder joint inspection. All of the requirements contained in the standard are discussed. The curriculum uses a slide presentation, a student workbook, practical exercises, quizzes and exams. Practical exercises include demonstrating techniques for surface mount soldering and assembly cleaning and demonstration of students' competency for using these techniques in a manner that produces hardware that meets the requirements of the standard. The criterion for student success in the practical exercises is determined based on the level of certification sought: inspector or operator. Additional classroom time and demonstration of teaching capability are required in the instructor course. A

significant portion of the course material is identical for the three Initial training levels enabling students to be grouped together for most parts of the Initial training courses. Retraining courses for operators, inspectors, and instructors are overviews of the information provided in the corresponding Initial course. Course durations are shown above. These courses are a prerequisite for NASA-STD-8739.2 operator, inspector and instructor certification.

3. For NASA-STD-8739.3, Soldered Electrical Connections (Hand-soldering)

Course Names from Table 2-2a and 2-2b:
8739.3 Operator/Inspector Initial, course duration: 5 days
8739.3 Level B Instructor Initial, course duration: 7 days
8739.2 Operator/Inspector Re-training, course duration: 2 days
8739.2 Level B Instructor Re-training, course duration: 2 days

These courses provide instruction to those who are responsible for using hand-soldering techniques for assembling printed wiring assemblies per NASA-STD-8739.3, Soldered Electrical Connections. Topics include material selection, parts and material quality assurance and preparation, pre-assembly inspections, part placement, and solder joint inspection. All of the requirements contained in the standard are discussed. The curriculum uses a slide presentation, a student workbook, practical exercises, quizzes and exams. Practical exercises include demonstrating techniques for hand-soldering and assembly cleaning and demonstration of students' competency for using these techniques in a manner that produces hardware that meets the requirements of the standard. The criterion for student success in the practical exercises is determined based on the level of certification sought: inspector or operator. Additional classroom time and demonstration of teaching capability are required in the instructor course. A significant portion of the course material is identical for the three Initial training levels enabling students to be grouped together for most parts of the Initial training courses. Retraining courses for operators, inspectors, and instructors are overviews of the information provided in the corresponding Initial course. Course durations are shown above. These courses are a prerequisite for NASA-STD-8739.3 operator, inspector and instructor certification.

4. For NASA-STD-8739.4, Crimping, Interconnecting Cables, Harnesses, and Wiring

Course Names from Table 2-2a and 2-2b:
8739.4 Operator/Inspector Initial, course duration: 5 days
8739.4 Level B Instructor Initial, course duration: 7 days
8739.4 Operator/Inspector Re-training, course duration: 2 days
8739.4 Level B Instructor Re-training, course duration: 2 days

These courses provide instruction to those who are responsible for building electrical cables and harnesses per NASA-STD-8739.4, Crimping, Interconnecting Cables, Harnesses, and Wiring. Topics include wire and cable preparation, connector contact installation onto wire and into connectors, crimp ring and backshell installation onto cables, installation of splices, installation

of grounding wires, harness manufacturing techniques, quality control practices, and quality assurance measurements. All of the requirements contained in the standard are discussed. The curriculum uses a slide presentation, a student workbook, practical exercises, quizzes and exams. Practical exercises include demonstrating techniques for harness assembly and demonstration of students' competency for using these techniques in a manner that produces hardware that meets the requirements of the standard. The criterion for student success in the practical exercises is determined based on the level of certification sought: inspector or operator. Additional classroom time and demonstration of teaching capability are required in the instructor course. A significant portion of the course material is identical for the three Initial training levels enabling students to be grouped together for most parts of the Initial training courses. Retraining courses for operators, inspectors, and instructors are overviews of the information provided in the corresponding Initial course. Course durations are shown above. These courses are a prerequisite for NASA-STD-8739.4 operator, inspector and instructor certification.

5. For NASA-STD-8739.5, Fiber Optic Terminations, Cable Assemblies, and Installation

Course Names from Table 2-2a and 2-2b:
8739.5 Operator/Inspector Initial, course duration: 5 days
8739.5 Level B Instructor Initial, course duration: 7 days
8739.5 Operator/Inspector Re-training, course duration: 2 days
8739.5 Level B Instructor Re-training, course duration: 2 days

These courses provide instruction to those who are responsible for building fiber optic cables and harnesses per NASA-STD-8739.5, Fiber Optic Terminations, Cable Assemblies, and Installation. Topics include fiber optic cable performance, optical fiber and cable member preparation, optical fiber termini installation onto optical fiber, cable layer preparation and processing, splicing, cautions and protections to operators and hardware, and quality assurance measurements. All of the requirements contained in the standard are discussed. The curriculum uses a slide presentation, a student workbook, practical exercises, quizzes and exams. Practical exercises include demonstrating techniques for terminating optical fiber, splicing, and performing quality assurance measurements and demonstration of students' competency for using these techniques in a manner that produces hardware that meets the requirements of the standard. The criterion for student success in the practical exercises is determined based on the level of certification sought: inspector or operator. Additional classroom time and demonstration of teaching capability are required in the instructor course. A significant portion of the course material is identical for the three Initial training levels enabling students to be grouped together for most parts of the Initial training courses. Retraining courses for operators, inspectors, and instructors are overviews of the information provided in the corresponding Initial course. Course durations are shown above. These courses are a prerequisite for NASA-STD-8739.5 operator, inspector and instructor certification.

6. For GSFC-WM-001, Electrostatic Discharge Control

Course Names from Table 2-2a and 2-2b:
GSFC-WM-001 Operator Initial, course duration: 4 hrs
(New to this procurement) GSFC-WM-001 Operator Retraining, course duration: 1hrs
GSFC-WM-001 Program Monitor Initial, course duration: 2 days
GSFC-WM-001 Level B Instructor, Initial: 3 days
(New to this procurement) GSFC-WM-001 Program Monitor/Instructor Retraining, course duration: 4 hrs

These courses provide instruction to those who are responsible for setting up, maintaining, or working in electrostatic discharge controlled areas (EPAs) within the NASA GSFC Greenbelt and Wallops Flight Facility campuses, in accordance with the requirements of GSFC-WM-001, Electrostatic Discharge Control. Topics include personnel roles and responsibilities, technical requirements for EPA electrical performance, use of personal grounding devices, methods for performing quality assurance measurements, and data record requirements. All of the requirements contained in the implementation plan are discussed. The operator curriculum uses a slide presentation, instructor-led demonstrations, and a final exam. The program monitor and instructor classes use a slide presentation, practical exercises, and a final exam. Practical exercises include demonstrating techniques for setting up and measuring an EPA and demonstration of students' competency for using these techniques in a manner that results in compliant EPA set-ups. Additional classroom time and demonstration of teaching capability are required in the instructor course. A significant portion of the course material is identical for the three Initial training levels enabling students to be grouped together for some parts of the Initial training courses. The retraining course consists of overview of the information provided in the corresponding Initial course. Course durations are shown above. These courses are a prerequisite for GSFC-WM-001 operator, program monitor, and instructor certification.

7. For J-STD-001DS CIS, Space Level Soldering

Course Names from Table 2-2a and 2-2b:
J-STD-001xS CIS Modular Course Initial, Course duration: 2.5 to 5.5 days
(New to this procurement) J-STD-001xS CIT Modular Course, Course duration: 2.5 to 5.5 days
(New to this procurement) J-STD-001xS CIS Non-Modular Course, Course duration: 5 days
(New to this procurement) J-STD-001xS CIS Retraining, Course duration: 2 days

These courses provide instruction to those who are responsible for using surface mount soldering systems and hand-soldering techniques for assembling printed wiring assemblies per IPC J-STD-001xS, Space Applications Electronic Hardware Addendum to J-STD-001x Requirements for Soldered Electrical and Electronic Assemblies ("x" is current revision letter, as of 9/30/2011 this letter is "E"). Topics include material selection, parts and material quality assurance and preparation, pre-assembly inspections, part placement, and solder joint inspection. All of the requirements contained in the standard are discussed. The curriculum uses a slide presentation, a student workbook, practical exercises, quizzes and exams. Practical exercises include demonstrating techniques for surface mount and hand-soldering and assembly cleaning and demonstration of students' competency for using these techniques in a manner that produces

hardware that meets the requirements of the standard. Some polymeric applications requirements are also taught. The criterion for student success in the practical exercises is determined based on the level of certification sought: inspector or operator. Additional classroom time and demonstration of teaching capability are required in the instructor course. The curriculum for these courses and rules for use of these course and awarding of course completion certifications to students is controlled by the IPC. See www.ipc.org for more information. Course durations are shown above. These courses are a prerequisite for NASA certification of operators and inspectors who will perform duties on mission hardware held to IPC J-STD-001xS requirements.

8. Additional Informational Courses

Course Names from Table 2-2a and 2-2b:
Workmanship Overview, Course duration: 2 days
Connector Mate/Demate, Course duration: ?? days
Rework and Repair, Course duration: ?? days

These courses are for informational purposes and are not prerequisites for personnel certification. The first course provides an overview of the content of NASA-STD-8739.1, Polymeric Applications, NASA-STD-8739.2, Surface Mount Soldering, NASA-STD-8739.3, Soldered Electrical Connections, NASA-STD-8739.4, Crimping, Interconnecting Cables, Harnesses, and Wiring, and NASA-STD-8739.5, Fiber Optic Terminations, Cable Assemblies, and Installation. The second course provides an overview of GSFC's best practices and cautions relative to safe mating and demating of connectors and harnesses which interface with mission hardware. The third course covers twenty-four individual procedures including conformal coating removal, de-soldering, part replacement (including both through-hole and surface mount technology parts), and jumper wire installation. Real life situations are used as teaching aids along with video tapes and slides. Each student will use detailed instructions to repair their own printed wiring board.